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Enhanced coupling of electromagnons in Nd-doped $BiFeO_3$ nanoparticles near morphotropic phase boundaries

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Multiferroics, displaying multiple ferroic orders, have pushed the development of advanced electrically and magnetically controlled applications in recent years, owing to their strong magnetoelectric (ME) coupling [1, 2]. As the apparent consequence of dynamic ME effects, the electromagnons have been widely investigated. The electromagnons are considered as the origin of the giant magnetodielectric and magnetocapacitance effects, and their coupling strength also directly relates to the magnitude of these effects [3, 4]. Therefore, in this work, the electromagnons of $Bi_{1-x}Nd_xFeO_3$ (x = 0~0.2) are studied by terahertz time-domain spectroscopy, and the effects of doping concentrations on electromagnons are discussed. The results show that the $Bi_{1-x}Nd_xFeO_3$ exhibits phase change mediated electromagnon effects. The coupling weight is gradually increased at polar *R*3*c* structures and then come down at antipolar *Pbam* phase, where the weight at antipolar phase is less than that of pure *R*3*c* phase. Interestingly, the colossal coupling of electromagnons is observed at the polar-antipolar and antiferromagnetic-ferromagnetic phase boundaries. Our work offers an avenue for designing and choosing materials with better performances of magnetodielectric and magnetocapacitance.

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